Meta-analysis on the potential to substitute mineral fertilizers by biobased fertilizers derived from agro-residues

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Introduction

- European demand on N, P and K fertilizer for 2020 is forecasted to reach 16.5 Mt, 4.4 Mt and 4.7 Mt, respectively[1].
- Between 2 and 5 Mt of N and 0.6 Mt of P from waste streams are not being recovered for agricultural use[2].
- Agro-processing can serve as a third pillar to reconnect nutrient and carbon flows between crop production and animal husbandry. (Fig. 1)

Current work:

1) Collection of current existing and future promising techniques from farmers and agri-business research, operational groups and new pilot cases.
2) Selection of the submitted techniques for further investigation.

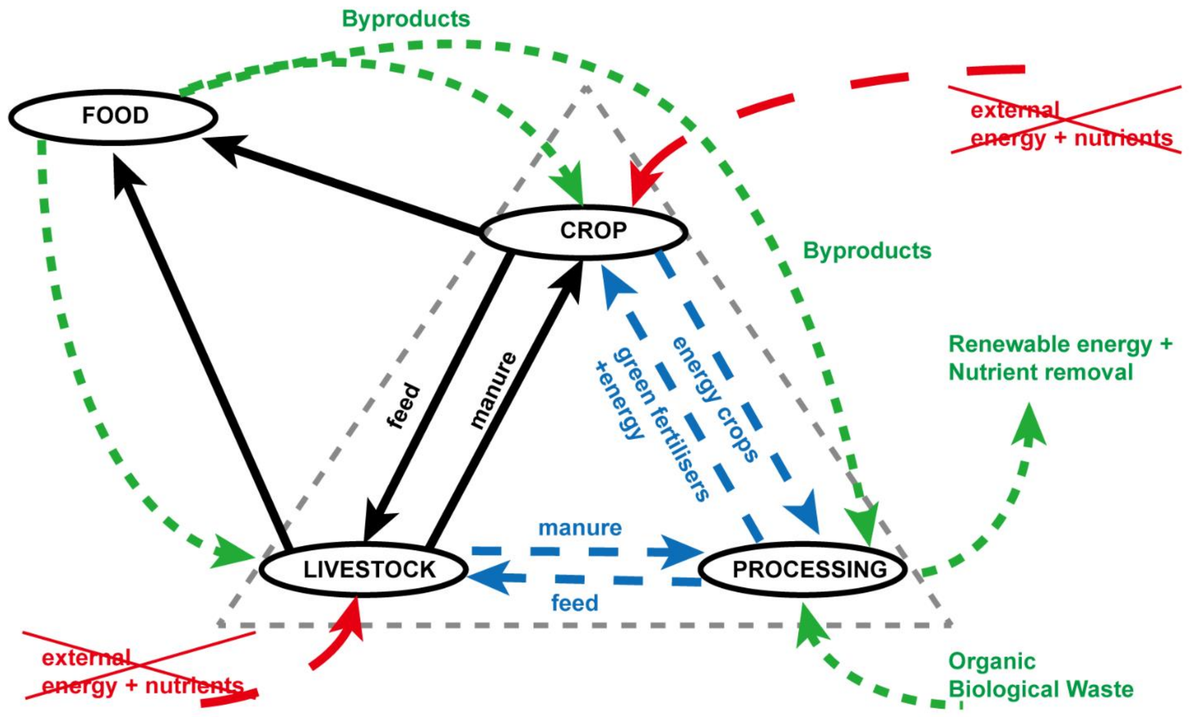


Fig. 1. Triangle model for reconnecting nutrient and carbon flows between conventional agro-pillars

Selection of submitted showcases

Monitored composting

FEEDSTOCK: Cattle and rabbit manure.

PROCESSING: The farm's cattle manure is transferred into compost using rabbit liquid manure to get a stabilized and hygienized product, including a monitoring system on manure evolution.

PRODUCT: Compost as an organic soil improver.

Source: CA17

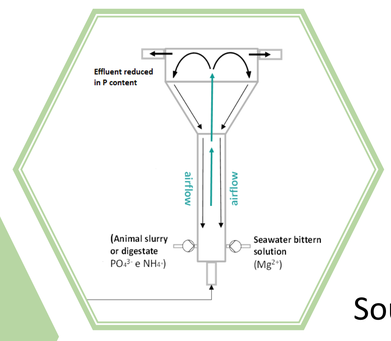
Bio-Phosphate

FEEDSTOCK: Animal bone.

PROCESSING: Recover P and refine C though a purposely designed and specific carbonization system with zero emission performance with interlinked wide range of BIO-NPK-C formulations.

PRODUCT: Animal Bone Char Bio-Phosphate granulate with specific material and surface characteristics.

Source: TERRA



Source: UMIL

Struvite crystallization

FEEDSTOCK: Liquid fraction of digestate and seawater bittern.

PROCESSING: Liquid fraction of digestate is used as ammonium and magnesium source and seawater bittern as magnesium source to produce struvite in an airlift reactor with a continuous air flux to create internal recycle flow.

PRODUCT: Struvite as a slow-released fertilizer.

Pellet and Evaporation

FEEDSTOCK: Pig manure.

PROCESSING: Pig manure first goes through the anaerobic digestion; the digestate is then separated, the thick fraction is dried to 90% dry matter for further processing to organic fertilizer pellets, and the fluid fraction is concentrated by the evaporation unit.

PRODUCT: Recovered N and K organic fertilizer concentrates.

Plasma technology

FEEDSTOCK: Manure or biogas digestate.

PROCESSING: The plasma unit fixates nitrogen from air by splitting the N_2 and O_2 molecules into atoms to form nitrogen oxides, which are absorbed into liquid manure or biogas digestate and combined with free ammonia to form ammonium nitrate.

PRODUCT: Ammonium nitrate fertilizer.

Source: EBA

Vacuum stripping

FEEDSTOCK: livestock slurry.

PROCESSING: Ammonia is released from water solution at reduced boiling point temperature when vacuum is applied in an enclosed reactor. Energy cost is reduced as a result of the lower heating requirement and the gas-phase ammonia mass transfer is boosted.

PRODUCT: An ammonia water that can be reused as a fertilizer.

Source: ZLTO

Source: IRTA

Reference:
[1] FAO (Food and Agriculture Organization Of The United Nations), 2017. World fertilizer trends and outlook to 2020: Summary Report- Rome.
[2] Buckwell, A. and Nadeu, E., 2016. Nutrient recovery and reuse (NRR) in European agriculture. A Review of the Issues, Opportunities, and Actions.

Acknowledgement

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